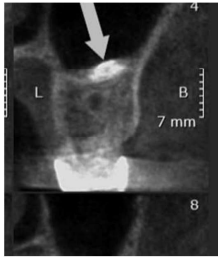
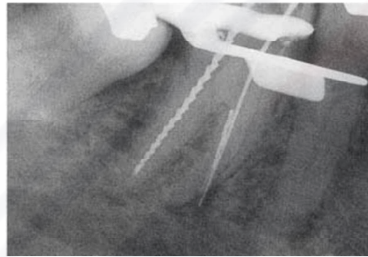


# Application of radiology in endodontics & periodontology



Lecture 8

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## The role of radiology in endodontics

- X-ray imaging serves at all stages of endodontics from diagnosis of odontogenic and nonodontogenic pathoses to treatment of the root canal system in a compromised tooth, biomechanical instrumentation, obturation, and healing assessment.



- **Intraoral periapical** radiography during endodontic procedures is still the most commonly used treatment adjuncts.

## The role of radiology in endodontics

**Intraoral radiographs** provide useful information for:

- The presence and location of peri-radicular lesions.
- Root canal anatomy.
- The proximity of adjacent anatomical structures.
- **They are used for preoperative, intraoperative and postoperative assessment and follow-up.**

## What are the shortcomings with intraoral radiographs in endodontics?

### 1- Compression three-dimensional structures

- Superimposition (overlapped structures).
- Information is gained basically in the mesio-distal direction, whereas, little or no information can be gained in bucco-lingual direction.
- Several intraoral views at different angles should be made to get information in the 3D. Even though, the identification of all relevant anatomic varieties or diseases is not guaranteed by multiple intra-oral radiographs.

What are the shortcomings with intraoral radiographs in endodontics?

## 2- Geometric distortion

- Intraoral parallel periapical radiographs provide a more accurate geometric representation of the object of interest than images taken by bisecting angle technique, but in endodontics procedures, paralleling technique may be challenging.
- it is impossible to completely eliminate the geometric distortion. For example, even with the use of paralleling technique, a minimum magnification of 5% can be expected.

SO, is it useful to use advanced imaging technique, CBCT in particular?

- In some cases (especially recurrence or persistent inflammatory lesions), it is very useful, but it is not the first thing you should do if you faced an endodontic complication.
  - Intraoral imaging techniques are the first choice, even in complications.
  - Intraoral imaging is the easiest and fastest choice among other choices.
- Also, you cannot always make a CBCT scans with gutta-percha coins inside the tooth.

What are the shortcomings with intraoral radiographs in endodontics?

## 3- Overlying anatomical structures

- It includes radiolucent anatomical structures (maxillary sinus and incisive foramen) and radiopaque structures (zygomatic process of maxilla, dense bone island).

SO, is it useful to use advanced imaging technique, CBCT in particular?



No need to CBCT scan in these cases.

SO, is it useful to use advanced imaging technique, CBCT in particular?



But in some cases, it is very useful.

How is CBCT useful in endodontics?



How is CBCT useful in endodontics?

- The clinician can choose and view slices of the volumetric data in all the orthogonal planes and in non-orthogonal planes.
- Least amount of distortion.

CBCT or MDCT?

- CBCT is better than MDCT in respect of radiation dose, the smaller voxels available in CBCT, the voxels are isotropic in CBCT in general (voxels are anisotropic in MDCT in general), and less metal artifacts in CBCT in comparison to MDCT.
- Especially in endodontics, CBCT is well suited for application in dental practice.
- MDCT is a hospital-based machine, making the access to it more difficult.

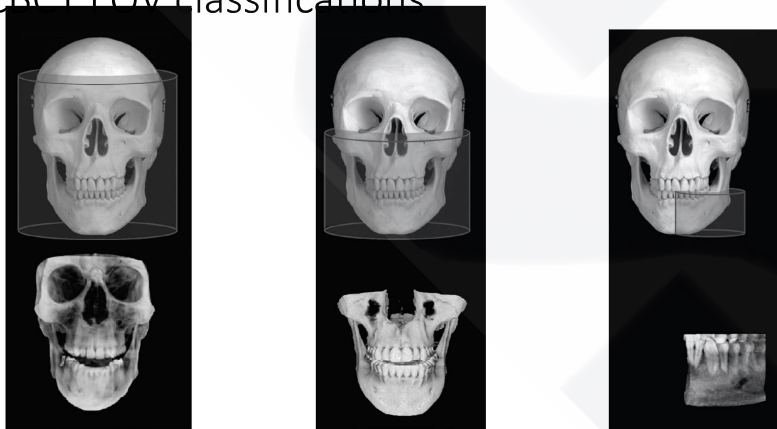
## CBCT FOV classifications

- Large field of view scans provide images of the entire craniofacial skeleton, enabling cephalometric analysis.
- Medium FOV scans image the maxilla or mandible or both.
- Focused or restricted FOV scans provide high-resolution images of limited regions.

## CBCT FOV classifications

- Small volume or localized region (focused, small field, limited field or limited volume), have a FOV height of  $\leq 5$  cm.
- Single arch: CBCT scans have a FOV height ranging from 5-7 cm within one arch.
- Inter arch: CBCT scans have a FOV height ranging from 7-10 cm.
- Maxillofacial: CBCT scans have a FOV height ranging from 10-15 cm
- Craniofacial: CBCTs have a FOV height greater than 15 cm.

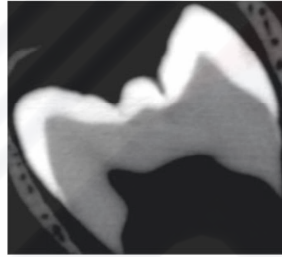
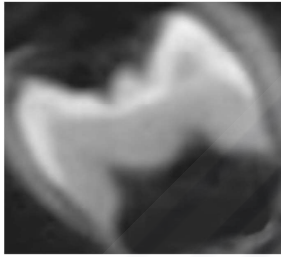
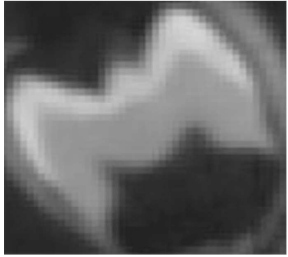
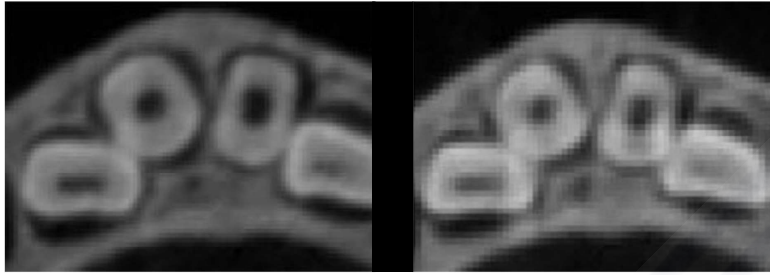
## CBCT FOV classifications



## CBCT FOV classifications

### **Why small field of view are preferable for endodontic procedures?**

- The smaller scan volume causes the higher spatial resolution of the image.
- It is favorable that the optimal resolution of any CBCT imaging system used in endodontics does not exceed the average width of the periodontal ligament space ( $200\text{ }\mu\text{m}$ ), because the earliest sign of periapical pathology being the discontinuity in the lamina dura and widening of the periodontal ligament space.
- Above all, the radiation dose is smaller when the field of view is smaller.

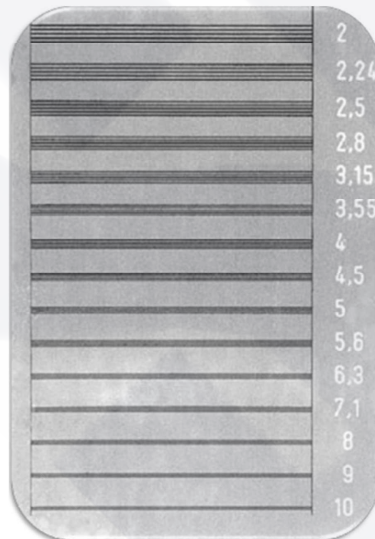


## CBCT limitations

- The spatial resolution and the contrast resolution of CBCT is lower than that of conventional film-based or digital intraoral radiography.
- Artifacts in CT system.
- The higher effective dose of ionizing radiation in comparison with conventional two-dimensional radiographs is not justifiable in every case.

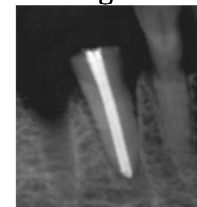
## CBCT limitations

With a voxel of 0.1 mm, the spatial resolution is equal to 5 line pairs / mm.



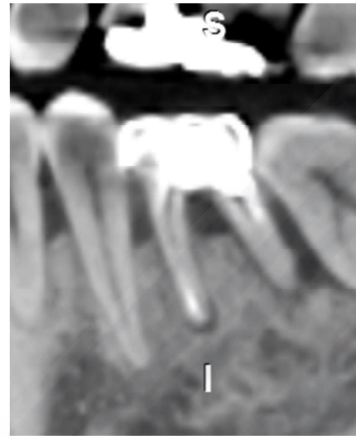
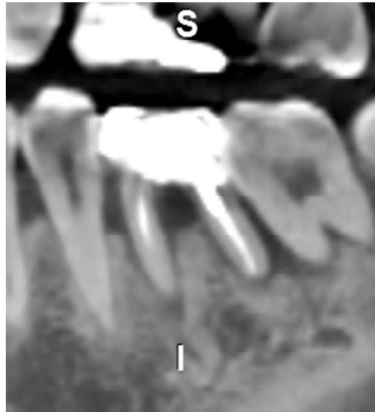
## CBCT limitations

- **Cannot be used for assessing the quality of root canal fillings.**
- Higher cost than conventional radiography.
- Studying the case is more time consuming than conventional radiographs.





## CBCT limitations



So, what are the applications of CBCT in endodontics?

### 1- Detection of apical periodontitis

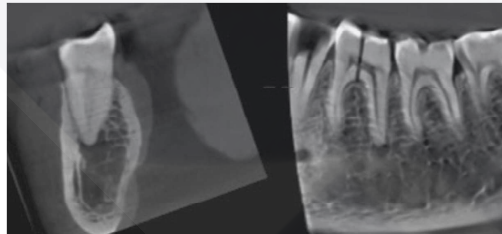
- CBCT is more accurate and sensitive than conventional radiographs.
- CBCT can demonstrate bone defects of the cancellous bone and cortical bone separately.
- CBCT presented significantly more findings, such as expansion of lesions into the maxillary sinus, sinus membrane thickening and missed canals.

So, what are the application of CBCT in endodontics?

### 1- Detection of apical periodontitis



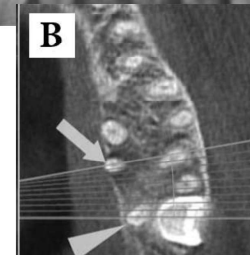
Periapical



CBCT

The lesion (2 mm) could be identified on the CBCT images but not on the periapical radiograph.

### 1- Detection of apical periodontitis



Two separate palatal roots of maxillary left second molar.

So, what are the application of CBCT in endodontics?

1- Detection of apical periodontitis



So, what are the applications of CBCT in endodontics?

1- Detection of apical periodontitis



Undetected and untreated second mesiobuccal canal (MB2).

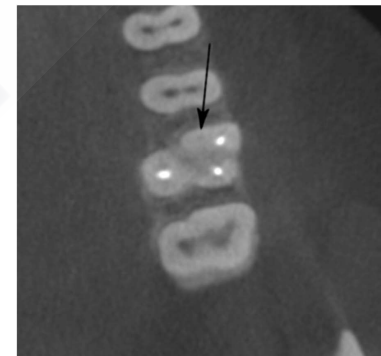
So, what are the applications of CBCT in endodontics?

1- Detection of apical periodontitis

- The prevalence of a second mesiobuccal canal (MB2) in maxillary first molars has been reported to be 69% to 93%.
- Conventional radiographs, **at their best**, can only reveal up to 55% of these configurations. In contrast, with increasing resolution of CBCT, the detection rate enhanced from 60% to 93.3%.

So, what are the applications of CBCT in endodontics?

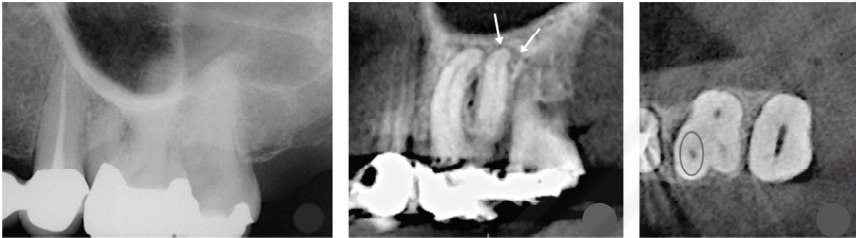
1- Detection of apical periodontitis



Missed second mesiobuccal (MB2) canal

So, what are the applications of CBCT in endodontics?

**1- Detection of apical periodontitis**



There is only one mesio-buccal canal in this case.

So, what are the applications of CBCT in endodontics?

**2- Assessment of Potential surgical sites**



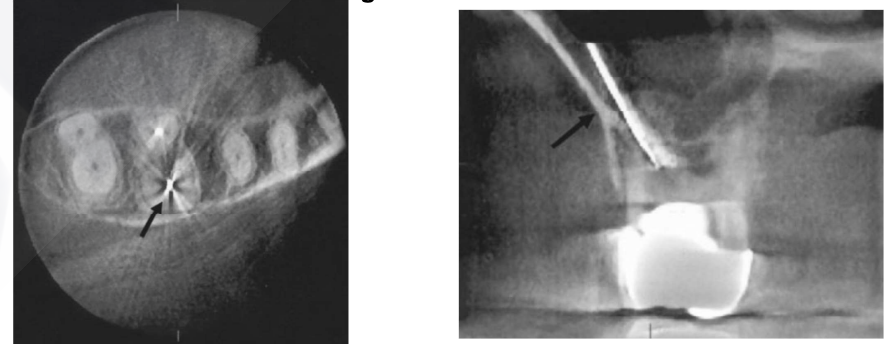
So, what are the applications of CBCT in endodontics?

**2- Assessment of Potential surgical sites**

- The spatial relationship of the specific tooth root(s) undergoing the surgical procedure (and the associated bony destruction) to adjacent anatomical structures such as the maxillary sinuses, the inferior dental nerve canal and the mental foramen can be precisely assessed.

So, what are the applications of CBCT in endodontics?

**2- Assessment of Potential surgical sites**



The fractured instrument in CBCT



So, what are the applications of CBCT in endodontics?

### 3- Assessment of traumatic dental injuries

- More sensitive in detection of horizontal root fractures than multiple periapical radiographs.

So, what are the applications of CBCT in endodontics?

### 4- Diagnosis of root resorption

- After dental luxation and avulsion injuries, external root resorption is a common complication. The sensitivity of conventional radiography is considerably poorer than CBCT in the detection of external root resorption in its early stages.
- External root resorption may mimic internal resorption and differentiation become difficult.

So, what are the applications of CBCT in endodontics?

### 3- Assessment of traumatic dental injuries

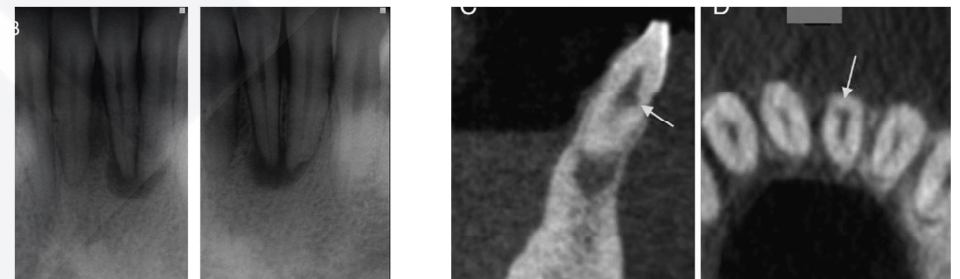
Both the right (11) and the left (21) central incisors are fractures.

Note that fracture of 21 is clear on intraoral and CBCT images, but the fracture of 11 is not clear on intraoral radiographs.



So, what are the applications of CBCT in endodontics?

### 4- Diagnosis of root resorption



This resorption seems to be external on periapical radiographs. On CBCT images, it is clear that it is internal.

So, what are the applications of CBCT in endodontics?

#### 5- Diagnosis of vertical root fractures

- Vertical root fracture is relatively an uncommon dental injury.
- radiographic appearances suggestive of VRF such as J-shaped and halo-shaped radiolucencies do not appear until considerable bone destruction has occurred and similar shaped radiolucencies may occur in cases of apical periodontitis not associated with VRF.

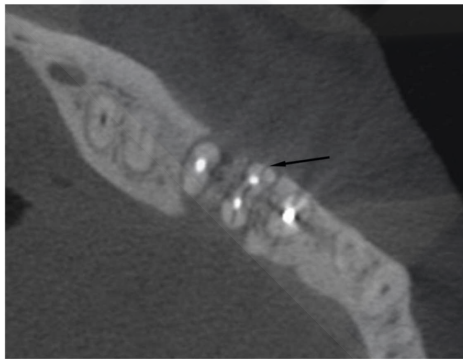
So, what are the applications of CBCT in endodontics?

#### 5- Diagnosis of vertical root fractures

- Small-FOV CBCTs should be used for representing VRFs of endodontically treated teeth. However, because scatter produced by the root filling or other high-density intra-radicular materials may incorrectly suggest the presence of a fracture, it should be taken into consideration when assessing root filled teeth for VRF using CBCT.

So, what are the applications of CBCT in endodontics?

#### 5- Diagnosis of vertical root fractures



Vertical root fracture in the lower molar mesial root.

# The End